

Islamic Republic of Iran
Vice Presidency for Strategic Planning and Supervision

**General Technical Specification and
Execution Procedures for Transmission
and Subtransmission Networks
Cables**

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**Energy Ministry - Tavanir Co.
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Cables

Technical Specification



1-General Requirements

All stages of design, material procurement, manufacture, inspection and preparation of low/medium voltage and control and power cables used in 63 to 400 kV substations shall be in accordance with the latest editions of the following standards and this specification:

IEC 60050: International electrotechnical vocabulary, electric cables

IEC 60228 : Conductors of insulated cables

IEC 60173 Colors of the cores of flexible cables and cords

IEC 60189: Low-frequency cables and wires with PVC insulation and PVC sheath

IEC 60227: Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V

IEC 60230: Impulse tests on cables and their accessories

IEC 60304: Standard colors for insulation for low-frequency cables and wires

IEC 60331: Fire resistance characteristics for electric cables

IEC 60332: Test on electric and optical fiber cables under fire conditions

IEC 60649: Calculation of maximum external diameter of cables for indoor installations

IEC 60719: Calculation of the lower and upper limits for the average outer dimensions of cables with circular copper conductors and of rated voltages up to and including 450/750 V

IEC 60724: Short-circuit temperature limits of electric cables with rated voltages 1 kV($U_m = 1.2$ kV) and 3 kV ($U_m = 3.6$ kV)

IEC 60811: Common test methods for insulating and sheathing materials of electric and optical cables

IEC 60853: Calculation of the cyclic and emergency current rating of cables.

IEC 60885-1: Electrical test methods for electric cables

In case when IEC standards are not reachable, the introduced BS standards or their equivalent VDE shall be used.

BS801: Composition of lead and lead alloy sheaths of electric cables

BS4066: Tests on electric cables under fire conditions.

BS5099: Voltage levels for spark testing on electric cables.

BS5467: Electric cables. Thermosetting insulated, armored cables for voltages of 600/1000 V and 1900/3300 V

BS6231: Electrical cables - Single core PVC insulated flexible cables of rated voltage 600/1000 V for switchgear and control gear wiring.

BS6234: Specification for polyethylene insulation and sheath of electric cables.

BS6360: Specification for conductors in insulated cables and cords.

BS6500: Electric cables. Flexible cords.

BS6622: Specification for cables with extruded cross-linked polyethylene or ethylene propylene rubber insulation for rated voltages from 3.8/6.6 kV up to 19/33 kV

All the references mentioned in the above standards are also applicable.

2- Design and Manufacture

Conductors of low and medium voltage power cables shall be sized for the specified current carrying capacity.

All single phase power cables shall have 1 full sized conductor plus 1 neutral continuity conductor which in ampere rated not less than %100 of the phase conductor. Three phase power cables shall have 3 full size conductors plus 1 neutral continuity conductor which in ampere rated not less than %58 of the phase conductor.

All power and control cable run shall be of a single length with no splicing jointing. Conductors belonging to different feeders or group wires may not be located in the same cable.

CT and PT cables shall be 4 core design except cables for synchronizing signals which may be 2 core.

The risk of fire shall be restricted by selecting cables with self extinguishing sheaths and by suitable arrangement of the cable runs.

Protective earth wires shall be marked with yellow/green.

The servicing life of cable shall be at least equal to designed servicing life of substation. The cable shall keep its required insulation characteristics in nominal temperature range, Max. environmental temperature and the heat produced by cable during its servicing.

If the cable is installed in a moisturized condition, especially when buried in ground and in case installed in corrosive chemical environments, it shall keep its insulation characteristics.

For selecting power cables the following factors shall be considered:

- Continuous current carrying capacity
- Short circuit capacity

- Voltage drop

For selecting control cables, the following factors shall be considered:

- Permissible voltage drop
- Burdens and cover current factors of instrument transformers
- Highest load current

2-1- Cable Layers

Low/medium voltage, control and protection cables shall include the following layers:

2-1-1- Conductors

The conductor of Low/medium voltage cable shall be of class 1 or 2, made of uncoated copper or annealed copper with metal, aluminum or aluminum alloy coating according to IEC 60228. In low voltage cables conductor of class 5 of uncoated copper with metal cover can be used.

The conductors of control and power cables shall be made of copper and shall be stranded (min 7 strands) of not less than 2.5 mm² for switchyard and 1.5mm² for indoor. The exception to the above shall be subject to engineer's approval.

2-1-2- Conductor Covering (only for medium voltage cables)

Conductor covering shall be made of extruded semiconductors and tightly put on each conductor separately or uniformly on all the conductors.

2-1-3- Insulation

All low voltage power, control and protection cables shall be provided with fire retardant PVC insulation. All medium voltage power cables shall be provided with XLPE insulation suited for related class.

2-1-4- Insulation Covering (only for MV cables)

The screen over the insulation of medium voltage power cables shall be of strippable extruded semi-conducting cross-linked polyethylene.

2-1-5- Metal Sheath (only for medium voltage, control and protection cables)

All cables for CT and PT circuits, control circuit and medium voltage power cables shall be copper shielded with their shield grounded at both ends. The thickness of lead-sheath shall be such that to withstand the maximum earth fault current for 1 second.

2-1-6- Armour

Wires of round or flat armour shall be of galvanized steel, copper or tin coated copper, aluminum or aluminum alloy. Steel stripes shall be of hot/cold rolled steel with preferred quality.

The tapes used in the armour of single core cables shall be of non magnetic (aluminum) material (except for single core DC cable, connecting to battery terminals, which shall be unarmoured and of flexible type). The armour shall withstand the ground fault current for 1 seconds. The necessary considerations shall be taken for safety of armour against the corrosion. If the inner metal layer and armour are of different material they shall be separated with an extruded sheath from each other. The material of this sheath shall be the same as outer sheath. If necessary materials are used for protecting the cable against the moist in metal layers, there is no need to use separating sheath. For reducing the electrical resistance of armour it can be used enough copper wires or tin coated copper between armour.

2-1-7- Outer Sheath

All cables shall be covered with a sheath made of thermoplastic (PVC or poly ethylene) or electrometric composites (poly chloroprene, koloro-sulphate polyethylene or similar polymers). This sheath shall be fire retardant and made of water proof materials.

In case of request, added chemical materials can be used for special purposes like protection against termite, but this shall not be harmful for human or environment.

The color of outer sheath shall be black, but in the case of agreement, other color can be used if needed for special applications.

2-1-8- Inner Cover and Fillers

Inner cover and fillers shall be made of semiconductors and resistant against moist penetration. Inner cover can be extruded or coiled. For cables with round core, excluding the ones with more than five cores, using the inner coiled cover is allowed only if the gaps between cores are completely filled. A proper textile layer can be used before inner extruded cover. The material used in inner covers and fillers shall be suitable for operation temperature of the cable and compatible with the insulation materials. In cables with metal cortex, concentric conductor or uniform armour, the inner cover can be neglected just of the outer shape of the cable remains circular and no stickiness occurs between the conductor and the sheath. The concentric conductor shall be used (if necessary) in multi core cables on the outer cover and in single core cables on the insulation or inner cover.

2-2- Cable Drums

Cable drum shall be pressure impregnated against fungal and insect attack. The diameter of the drum shall be suitably large enough in order to its physical characteristics doesn't change. Design, structure and strength of the drums shall be in such a way that provides the ability of transportation to the desired destiny without any displacement, attrition or any other damages caused from transportation. The cable drums shall be able to bear all tensions caused by installation process. The end of each conductor shall be suitably water proofed and tied to the drum.

In addition to the marks needed for transportation, each cable drum shall have a plate specifying serial number, number and dimensions of conductors, length of cable, the arrow indicating the end of the cable and gross and net weight. The measurements marks shall be provided in every 1 meter length of the cable.

2-3- Cable Lengths

Cables shall be supplied in maximum drum lengths subject to transport limitation.

2-4- Core Identifications

Cables shall be color coded as follows:

- Red, yellow, green for phase conductors
- Black for AC neutrals and other connections
- Yellow / green for ground connections (only for low voltage cables)
- Gray for DC circuits

Conductors of control cables shall have numerical marks. These marks shall be of best quality and shall not be removed because of contact during the transportation. The numbers shall be distinguishable.

The manufacturers identification shall be provided throughout the cable continuously on a suitable place and shall have following details.

- Manufacturers name and / or trade mark
- Year of manufacture
- Nominal voltage
- Number of cores and cross section area
- Cable length

3- Data & Networking Cables

Data & networking cables of multi pair and of J-Y(ST)Y is suggested. Data & networking cables shall be protected against external electrical effects by metal shields and plastic cover. Wires with 0.4 mm diameter are for utmost 10 pairs and wires with 0.6 mm diameter are for more than 10 pairs.

The separate paired wires shall be distinguished by related colors and codes.

External shield shall be connected to ground at one end of the cable.

4- Twisted Pair Cables

Cable use for transducer signals shall be screen twisted pairs. These cables may consist of either shielded or unshielded twisted- wire pair cables. Type of the cables shall be subject to Engineer's approval. For shielded cable, each pair is individually shielded with an aluminum / polyester foil, followed by an overall tinned copper braid shield. The screens shall be earthed only at one point in the substation control room.

5- Required Tests

The following tests shall be done according to IEC 60502, 60853-3, 60230, 60332-1 on the cables.

5-1- Routine Tests

- Test of measurement of electric resistance of conductors
- Partial discharge test
- Voltage test

5-2- Sampling Tests

- Conductor examination
- Check of dimensions

- Voltage test for cables of rated voltage above 3.6/6 (7.2) kV
- Hot set test for XPLE insulations and elastomeric sheaths

5-3- Type Tests

5-3-1- Type Tests of Medium Voltage Cables

- Partial discharge test
- Bending test (followed by a partial discharge test)
- Tan δ measurement
- Heating cycle test (followed by a partial discharge test)
- Impulse test followed by a voltage test
- Voltage test for 4 hours
- Receptivity of semiconductor screens

Note:

Electrical type tests of medium voltage cables with non covered insulation are similar to electrical type tests of low voltage cables. In addition to those tests, impulse test shall also be applied on these cables.

5-3-2- Electrical Type Tests of Low Voltage Cables

- Insulation resistance measurement at ambient temperature
- Insulation resistance measurement at maximum conductor temperature in normal service
- Voltage test for 4 hours

5-3-3- Non- Electrical Type Tests

- Dimension measurement
- Tension resistance
- Length increasing in torn apart
- Thermoplastic characteristic measurement
- Mass reduction test in air furnace
- Heat shock test
- Hot set test
- Flame retardance test
- Water absorption tests
- Thermal stability test (only for medium voltage cables)
- Shrinkage test
- Measurement of carbon black content of black PE over sheath
- Strip ability test for insulation screen (only for medium voltage cables)
- Water penetration test (only for medium voltage cables)

6- Cable Accessories (for control and low voltage power cables)

Cable glands shall be suitable for the type of cable to which they are fitted. Cable glands shall be made of stainless steel. Adequate quantity of plastic cable tie shall be considered.

All equipment and accessories required for completion of cabling work shall be provided.

7- Medium Voltage Sealing End

Outdoor weather- proof sealing ends suitable for the MV cables shall be supplied by the Contractor Complete with all accessories. Outdoor sealing ends shall have a design which will create no stresses more than the values considered for cables.

Proper ground connection shall be provided to station grounding. Material and accessories shall be supplied.

The contractor shall give full details drawings and material data and methods.

8-Packing, Transportation and Installation

All parts shall be carefully packed in strong wood cases on suitable part of which its contents, name of the manufacturer and date of manufacturing shall be indicated. All supplied cable shall be shipped on wooden reels.

No joints shall be allowed in any cable run unless approved by the engineer. All cable conductors shall be identified at each end, and also at reasonable distance intervals of the cable by a method approved by the engineer. Burying cables directly in the ground shall be kept to a minimum, and each case shall be subject to the approval of the engineer. The arrangement of the cables and all methods of laying shall be planned to provide in orderly formation, free from unnecessary bends and crossings, which will permit the removal of any one cable without undue disturbance to adjacent cables. Power cable shall be laid with suitable distances from each on the cable trays (at least cable diameter) to provide good cooling and avoid fire propagation. No cables are to be laid in ducts or trenches with other services such as oil pipes, steam or water pipes, etc.

8-1-Cable Laid Direct in Ground

where cables are to be laid directly in the ground, they shall be placed in the center of a trench which shall be as straight as possible. A layer of fine riddled sand shall be placed on the bottom of the trench to form a bed for the cables. The layer must be consolidated to a finished depth of 80 mm. After the cables have been laid in the trench they shall be covered with riddled sand, well punned, over and around the cables to a level 80 mm above the top of the cable.

Protective covers shall then be placed over the cables and shall consist of interlocked slabs of reinforced concrete block or other material to an approved specification. The covers shall be of adequate width to protect the cables or group of cables and provide a minimum overlap on each side of 50mm. The trench shall then be back filled.

Unless otherwise approved, control and auxiliary cables shall not be laid under the same covers as power cables. The filling in of trenches shall not be commenced until the cables in the trenches have been inspected by the Engineer. Back filling shall proceed in 150mm layers, each layer being well consolidated.

In crossings under heavy load traffic roads the cables shall be run through a hard PVC conduct band with adequate diameter.

The depth of laying cables running through ducts or pipes below the surface of the ground to the top of the ground shall not be less than 600 mm under a footway and 750 mm under a roadway or in unmade ground.

To prevent the entry of water or vermin into building or cable trenches, both the ducts and seals shall be fire resistant.

8-2-Racks, Cleats, Trays and Ladders

Each cable shall be securely supported at a point not more than 1 m from its termination, and where vertical runs pass through the floors, immediately above the floor. The type of installation used for the support system shall be to an approved method. The clearing arrangements for cables shall be sufficient strength to withstand the forces set up during short circuit conditions.

Racks shall be constructed of mild steel and may be either from standard sections or a preformed package system of metal frame construction.

Ladder and trays shall be capable of supporting an increase of 25% in cable weights. The design shall include a factor of safety to guard against permanent distortion when the ladders and trays support erection staff during cable installation.

Auxiliary and control cables as well as thermocouple cables shall be run in separate trays/ladders than those of power cables. All cable supports shall be suitable for withstanding forces which may result from the occurrences of short circuit currents in the cables.

8-3- Guards

Where cables are exposed to mechanical damage, sheet steel guards shall be provided to protect them, at the request of the Engineer or alternatively they may run through rigid galvanized steel conduits.

8-4- Route of Cables

The layout of all cables shall be arranged to give adequate clearance from other services. Cables shall generally be routed to avoid hot or fire risk areas. In cases where such passages are unavoidable special heat resistant cables shall be used.

Those cables which are installed in moist or corrosive situations shall be sheathed with a suitable protective serving.

Where necessary, protection from solar radiation shall be provided (e.g. covered trays)

Equipment which are required for emergency use shall be cable using routes which are different to , or segregated from, the routes used for normal running equipment.

8-5. Cable Markers and Records

Approved surface markers shall be provided to indicate the position of all cables laid directly in the ground, in ducts or in pipes. Such markers shall be erected as soon as the laying of the cable is completed.

It is preferred that the route of the cable shall also be marked by a continuous length of 150mm wide plastic tape, lettered with a warning in English and Farsi. The tape is to be buried 150mm below the surface and is to faithfully follow the route of the cable.

9- Required Documents

9-1- Documents to be Provided By The Tenderness

- Filled schedule CABLE(II)
- Catalogue and technical pamphlets
- Summary of type test reports
- Manufacturer references
- Summary of exceptions to technical specification
- List of special tools
- List of spare parts

9-2- Documents to be Provided By Contractor/ Supplier

The electrical and mechanical design, fabrication, factory testing, marking, packing, transportation, housing, erection, site tests, operation and maintenance manuals of cables are as follows but not limited to:

- Design calculation sheets to establish adequacy of cables in any respect
- Details of cable components
- Wiring drawings, dimensions, list and numbers, necessary safety distances, nominal electric quantities,
- Quantities, tables and routine test manuals
- List of components
- List of drawings
- Type test reports
- Housing, erection, operation and maintenance manuals
- Packing details
- Technical documents of insulation

**Schedule: Technical Specification of (Low / Medium Voltage, Protection and Control Cables
(to be Filled by Buyer)**

ITEM	DESCRIPTION	TECHNICAL CHARACTERISTICS
1	Environmental condition	
1-1	Altitude above the sea level	Meter 1000/1500/2000/2500
1-2	Max. Ambient temperature	°C 40/45/50/55
1-3	Min. Ambient temperature	°C -25/-30/-35/-40
1-4	Relative Humidity	% 90/95/more than 95
2	Medium voltage power cable	
2-1	Design voltage	kV 20/33
2-2	No. of cores	*
2-3	Section area of conductor	mm ² *
2-4	Conductor Material	copper / aluminum
2-5	Conductor type	stranded
2-6	Insulation material	*
2-7	Armour:	
2-7-1	Armour type	*
2-7-2	Armour material	*
2-8	Material of metal sheath	*
2-9	Power frequency voltage test	kV 30/45
2-10	Insulation withstand against lightning impulse	kV 125/170
2-11	Short circuit stability level:	
2-11-1	Symmetric current	kA *
2-11-2	Dynamic current	kA _{peak} *
2-11-3	Duration of short circuit	Sec 1
2-12	Short circuit current / time withstand of armour	kA/ Sec 1/*
2-13	Short circuit current / time withstand of shield	kA/ Sec 1/*
3	Low voltage power cable	
3-1	Design voltage	kV 600/1000
3-2	No. of cores	*
3-3	Section area of conductor	mm ² *
3-4	conductor material	copper
3-5	conductor type	stranded
3-6	Insulation material	PVC
3-7	Type of armour for single/multi core cables	wire
3-8	Armour material for single/multi core cables	Galvanized steel

**Schedule: Technical Specification of (Low / Medium Voltage, Protection and Control Cables
(to be Filled by Buyer)**

ITEM	DESCRIPTION	TECHNICAL CHARACTERISTICS
3-9	Material of metal sheath (if exist)	*
3-10	Material of outer sheath	Extruded PVC
3-11	High voltage test	kV 3.5
3-12	Short circuit withstand current /time of conductor	kA/ Sec */1
3-13	Short circuit withstand current /time of armour	kA/ Sec */1
4	Control and protection cables	
4-1	Voltage grade:	
4-1-1	CT and PT cables	V 600/1000
4-1-2	Control cables	V 450/750
4-2	Conductor material	twisted copper
4-3	No. of cores	*
4-4	Section area of conductor	mm ² *
4-5	Type of conductor	stranded
4-6	Type of insulation	PVC
4-7	Inner insulation	extruded PVC
4-8	Type of metal sheath	*
4-9	Type of armour	wire
4-10	Armour material	Galvanized steel
4-11	Material of outer sheath	Extruded PVC/ poly ethylene / elastrometric composites
4-12	Thickness of outer sheath	*
4-13	High voltage test for 5 min:	
4-13-1	CT and PT cables	kV 3.5
4-13-2	Control cable	kV 2.5
4-14	Short circuit withstand current /time of conductor	kA/ Sec 1/*
4-15	Short circuit withstand current /time of armour	kA/ Sec 1/*
4-16	Short circuit withstand current /time of shield	kA/ Sec 1/*
5	Medium voltage sealing end	
5-1	Material	*
5-2	Creepage distance	*

* These quantities will be specified by the engineer.

**Guarantee Data for Low / Medium Voltage Power Cable, Control and Protection Cables
(to be Filled by Seller)**

ITEM	DESCRIPTION	TECHNICAL CHARACTERISTICS
1	Generals	
1-1	Manufacturer's name and country:	
1-1-1	Low voltage power cable	
1-1-2	Medium voltage power cable	
1-1-3	Control and protection cables	
1-2	Manufacturer's type designation:	
1-2-1	Low voltage power cable	
1-2-2	Medium voltage power cable	
1-2-3	Control and protection cables	
1-3	Applicable standard:	
1-3-1	Low voltage power cable	
1-3-2	Medium voltage power cable	
1-3-3	Control and protection cables	
1-4	Site and ambient temperature:	
1-4-1	Max. design temperature	°C
1-4-2	Min. design temperature	°C
1-5	Documents(test reports /catalogues/ maintenance and installation manuals / references)	
2	Medium voltage power cables	
2-1	Voltage designation	kV
2-2	Frequency	Hz
2-3	Section area of conductor	mm ²
2-4	No. and size of conductors	mm
2-5	Material of conductor	
2-6	Type of conductor	
2-7	Shape of conductor	
2-8	Conductor screening:	
2-8-1	Material	
2-8-2	Thickness of layer	mm
2-8-3	Short circuit withstand current /time	kA/Sec
2-9	Type of insulation / Manufacturer	
2-10	Thickness of insulation	mm
2-11	Insulation screening:	
2-11-1	Material	
2-11-2	Thickness of layer	mm

**Guarantee Data for Low / Medium Voltage Power Cable, Control and Protection Cables
(to be Filled by Seller)**

ITEM	DESCRIPTION	TECHNICAL CHARACTERISTICS
2-12	Metal sheath:	
2-12-1	Material	
2-12-2	Min. thickness at any point	mm
2-12-3	Short circuit withstand current	kA
2-12-4	Short circuit withstand time	Sec
2-13	Nominal diameter over metal sheath	mm
2-14	Armour:	
2-14-1	Material	
2-14-2	Double type armour:	
2-14-2-1	Thickness of tapes	mm
2-14-2-2	Width of tapes	mm
2-14-2-3	Max. gap between tapes	mm
2-14-3	Single wire armour:	
2-14-3-1	Round or flat	
2-14-3-2	No. of wires	
2-14-3-3	Thickness of wire	mm
2-14-4	Double wire armour:	
2-14-4-1	No. of wires in first layer	
2-14-4-2	No. of wires in second layer	
2-14-4-3	Diameter of wires	mm
2-14-5	Short circuit withstand current	kA
2-14-6	Short circuit withstand time	Sec
2-15	Material and color for outer covering	
2-16	Nominal overall diameter of completed cable	mm
2-17	Nominal weight of completed cable	kg/km
2-18	Min. radius of bend round:	
2-18-1	In ground or air	m
2-18-2	In ducts	m
2-19	Max. DC resistance of conductor at 20 °C	Ω/km
2-20	Resistance of conductor at 90 °C	Ω/km
2-21	Equivalent star resistance of the three phase circuit at rated frequency	Ω/km
2-22	Max. electrostatic capacitance	Ω/km
2-23	Max. temperature attained by conductor and metal sheath under short circuit:	
2-23-1	Conductor temperature	°C
2-23-2	Shield temperature	°C

**Guarantee Data for Low / Medium Voltage Power Cable, Control and Protection Cables
(to be Filled by Seller)**

ITEM	DESCRIPTION	TECHNICAL CHARACTERISTICS
2-24	Impulse withstand voltage	kV _{peak}
2-25	Max. permissible tension	N
3	Low voltage power cable	
3-1	Voltage designation	V
3-2	Frequency	Hz
3-3	Section area of conductor	mm ²
3-4	No. and size of conductors	mm
3-5	Material of conductor	
3-6	Type of conductor	
3-7	Shape of conductor	
3-8	Insulation:	
3-8-1	Type of insulation / Manufacturer	
3-8-2	Thickness of core insulation	mm
3-8-3	Min. thickness of insulation between conductors	mm
3-8-4	Min. thickness of insulation between core and metal sheath	mm
3-8-5	Insulation resistance at 20 °C	Mega ohm / km
3-9	Metal sheath:	
3-9-1	Material	
3-9-2	Thickness	mm
3-9-3	Short circuit withstand currents and time	kA/Sec
3-10	Armour:	
3-10-1	Type	
3-10-2	Material	
3-10-3	Thickness	mm
3-10-4	Short circuit withstand current and time	kA/Sec
3-11	Max. Permissible temperature	°C
3-12	Max. Installation temperature	°C
3-13	Min. radius of bend round	m
3-14	Impulse withstand voltage	kV _{peak}
3-15	Max. permissible tension	N
4	Control and protection cables	
4-1	Voltage grade:	
4-1-1	CT and PT cables	V
4-1-2	Control cable	V

**Guarantee Data for Low / Medium Voltage Power Cable, Control and Protection Cables
(to be Filled by Seller)**

ITEM	DESCRIPTION	TECHNICAL CHARACTERISTICS
4-2	Conductor material	
4-3	Conductor type	
4-4	Conductor shape	
4-5	Short circuit withstand current	kA
4-6	Short circuit withstand time	Sec
4-7	No. of cores and size:	
4-7-1	CT and PT cables	
4-7-2	Control cable	
4-8	Thickness of core insulation	mm
4-9	Insulation resistance at 20 °C	Mega ohm /km
4-10	Min. thickness of insulation between core and shield	mm
4-11	Min. thickness of outer sheath	mm
4-12	Metal sheath:	
4-12-1	Material	
4-12-2	Min. thickness	mm
4-12-3	Short circuit withstand current and time	kA/Sec
4-13	Armour:	
4-13-1	Material	
4-13-2	Nominal thickness	mm
4-13-3	Short circuit withstand current and time	kA/Sec
4-14	Type and color of outer sheath	
4-15	Max. permissible tension	N
4-16	Max. Permissible temperature of conductor in short circuit condition	°C
4-17	Max. Permissible temperature of metal sheath in short circuit condition	°C
5	Cable accessories	
5-1	Cable glands (Type and manufacturer)	
5-2	Cable lugs and connectors (Type and manufacturer)	
5-3	Clamps books and cleats (Type and manufacturer)	
5-4	Cable jointing (Type and manufacturer)	
5-5	Ferrules	

**Guarantee Data for Low / Medium Voltage Power Cable, Control and Protection Cables
(to be Filled by Seller)**

ITEM	DESCRIPTION	TECHNICAL CHARACTERISTICS
6	Twisted pair cable	
6-1	Type of conductor	
6-2	Overall diameter	mm
6-3	Insulation thickness	mm
6-4	Type of shields	
6-5	Jacket:	
6-5-1	Material	
6-5-2	Color	
6-5-3	Overall diameter	
6-6	Electrical properties:	
6-6-1	DC resistance of conductors	Ω
6-6-2	DC resistance of installed cable	Ω
6-6-3	Pair capacitance	μF
6-6-4	Impedance	Ω
6-6-5	Dielectric strength	
6-6-6	Rated voltage	V
6-6-7	Insulation resistance	
6-6-8	Propagation delay	Sec
7	Medium voltage sealing end	
7-1	Manufacturer and country	
7-2	Type of supporting insulator	
7-3	Number of parts	
7-4	External insulation:	
7-4-1	Material	
7-4-2	Color	
7-4-3	Creepage distance	
7-5	Conductor size	mm^2
7-6	Rated voltage	kV

**Guarantee Data for Low / Medium Voltage Power Cable, Control and Protection Cables
(to be Filled by Seller)**

ITEM	DESCRIPTION	TECHNICAL CHARACTERISTICS
8	Cable trays and fittings	
8-1	Manufacturer	
8-2	Applicable standard	
8-3	Thickness of sheet steel	
8-4	Protective coating details	
8-5	Standard dimension of unit piece	
9	Rigid pipes and fittings	
9-1	Manufacturer	
9-2	Applicable standard	
9-3	Type of construction	
9-4	Standard dimensions	
9-5	Protective coating details	